THE RELATIONSHIP BETWEEN PRIMARY TEMPOROMANDIBULAR JOINT DISORDERS AND CERVICAL SPINE DYSFUNCTION

A SUMMARY AND REVIEW.

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Abstract: The co-existence of primary temporomandibular disorders and cervical spine dysfunction is well documented. This paper reviews the anatomy and function of the temporomandibular joint and its primary disorders with particular reference to their possible effects on the cervical spine.

Keywords: Temporomandibular joint, TMJ, cervical spine, disorders, dysfunction.

INTRODUCTION

Almost 50% of the patient population display abnormalities that are qualitatively similar to patients suffering from temporomandibular (TMJ) disorders but for the most part are subclinical (1). The relationship between TMJ disorders and cervical spine dysfunction is well documented, with the causes of the latter often being multifactorial (2-7). Rocabado (8) went as far as to say that no examination of the craniovertebral region is complete without a thorough check of the jaw joints and associated musculature as there is a functional interdependence between the cervical spine and the TMJ, in that neck and jaw movements, like chewing, swallowing and respiration etc., are biomechanically linked. Kirvesskari et al (9) showed a direct correlation between TMJ dysfunction and mobility of the cervical spine and neck and shoulder tenderness, while Kopp et al (10) stressed the inter-relationship between the atlanto-occipital joints and the TMJ via the arthromuscular control loop. Gelb (7) in his text on head, neck and TMJ pain and dysfunction provides the reader with quite dramatic pictorial evidence of the effects of TMJ dysfunction on not only the cervical spine but posture in general. He cites the work of the American Academy of Physiologic Dentistry and the American Academy of Functional Prosthodontics with before and after postural xrays. Such postural deformities as scoliosis, hyperkyphosis, hyperlordosis and anterior weight-bearing are seemingly corrected or improved by functional prosthodontics.

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ANATOMY AND BIOMECHANICS OF THE TMJ

Although it is not within the scope of this review to provide a detailed description of TMJ anatomy and biomechanics, it is necessary to briefly outline the structural and functional anatomical relationships between the TMJ and the cervical spine before discussing cause and effect relationships.

The TMJ is a highly specialised articulation and can best be described as a hinge joint with a moveable socket (11). It is a compound joint with four articulating surfaces (articular eminence, superior disc surface, inferior disc surface and condylar surface). The articular surfaces are not covered with hyaline cartilage but with dense fibrous tissue that are capable of constant remodelling in response to the static dynamic, and demands placed on them throughout their lifetime.

Movement is accomplished by rotation followed by translation. This involves a highly dynamic combination of opening, closing, protrusion and laterotrusion. The opening sequence involves the use of the inframandibular muscles; inferior lateral pterygoid, digastrics, supra and infrahyiod. In order to prevent the head being pulled down as these muscles exert a downward pull on the mandible the posterior cervical muscles must act to stabilise the cranium, thereby permitting the mandible to drop away from it. Elevation is also assisted by the posterior cervical muscles in that if unopposed the elevator muscles would, in their attempt to pull the mandible upward, cause the head to drop forward. The elevator muscles included the masseter, medial pterygoid and superior lateral pterygoid groups. Laterotrusion involves the use of the lateral pterygoid and medial pterygoid and temporalis muscles. As the mandible is a single bone with a bilateral articulation anything which affects one joint must in some way affect the opposite joint (5).

Collectively the muscles of mastication are innervated by the motor root of the mandibular division of the fifth cranial nerve. The sensory root of this nerve supplies the mucous membrane of the cheek, lower lip, mouth and anterior two thirds of the tongue, the upper half of the ear, the external auditory meatus and tympanic membrane, the skin of the temple, scalp, chin, jaw and lower lip, as well as the sublingual, parotid and mandibular glands (12). The trigeminal nerve terminates in three nuclei, the main sensory nucleus, the descending or spinal nucleus and the mesencephalic nucleus. Basically the main sensory nucleus is concerned with tactile impulses, the spinal nucleus with pain and temperature sensation and the mesencephalic nucleus with stretch and pressure receptors of the masticatory muscles, teeth and hard palate (13). The descending tract of the trigeminal nerve extends as far as the second cervical segment (11). Of particular importance is the inter-relationship between the nucleus caudalis of the spinal nucleus and the upper cervical spine segments, C1, C2 and C3. Neurons of the three divisions of the trigeminal nerve and cranial nerves VII, IX and X share a common pool with neurons of the upper three cervical segments (2).

PRIMARY TMJ DYSFUNCTION

DeSteno (14) describes the components of TMJ dysfunction in terms of the "TMJ Triad". These components are categorised into, predisposition, tissue alteration and psychological dependence. Predisposition can be subdivided into intrinsic or genetic and extrinsic or acquired. For TMJ dysfunction to be diagnosed all three components must be present. That is the patient must be predisposed to TMJ dysfunction, the neuromuscular, skeletal or dental tissues must undergo some pathological change and there must exist a degree of stress sufficient to cause excessive muscle tension, clenching and or bruxing of the teeth.

Genetic predisposition ranges from congenital weakness to absence of the whole or part of muscles and ligaments, as well as skeletal deformities. Acquired predisposition encompasses traumatic injuries which may affect growth centres thus causing developmental asymmetry of the condylar heads, or ligament and muscle damage causing joint instability. Nutritional deficiencies and abnormal endocrine function may also contribute to acquired predisposition.

The pathological alterations in the skeletal, dental and neuromuscular structures are in fact the end result of the "TMJ Triad". When predisposition produces an altered maxillo-mandibular relationship and psychological factors cause habitual bruxism or clenching of the teeth a combination of the following situations occurs: (1) wear of teeth; (2) dissolution and reabsorption of alveolar bone; (3)pathological alterations of the TMJs; and (4) muscular spasm and pain. Joint function within normal physiological limits will not cause tissue change, it is only when tissues are required to function beyond their designed capacity that pathological change occurs. For example, stress produced by bruxism or clenching may induce bone loss or ligament and muscle weakness. Arthritic changes affecting the TMJ, such as rheumatoid and osteoarthritis, must also be considered in the context of tissue alterations. Osteoarthritis is the most common pathosis of the TMJ and is usually preceded by an altered maxillo-mandibular relationship, causing displacement of the condylar head during occlusion. It is this occlusal relationship that is of paramount importance in any discussion of the pathophysiology of TMJ dysfunction. The degree of malocclusion of the teeth determines the degree to which the maxillo-mandibular relationship is altered, when the teeth are in contact (13). According to some authors (11)(15)(16) malocclusion is the most common cause of TMJ dysfunction. Malocclusion, by upsetting the delicate balance between both TMJs, may create muscle imbalances by changing the resting length and function of the masticatory muscles (3), increase intra-articular pressure and ligament stress (5). Other factors that may contribute to tissue alteration and TMJ dysfunction from malocclusion include congenital and developmental anomalies of the maxilla, mandible, unilateral and bilateral crossbites, rotated or malposed teeth or missing teeth.(14)

In general the acute symptoms of TMJ dysfunction are muscular in nature, while the more chronic conditions also include the involvement of the other connective tissues. Furthermore longstanding malocclusion may result in permanent changes within the joint itself due to adaptation (14).

The psychological component of the "Triad" must be present before the joint becomes symptomatic. That is although an individual possesses both the necessary predisposition and tissue alterations, without the psychological aspect causing abnormal muscle tension and or bruxism the joint may remain asymptomatic, yet remain dysfunctional (14).

TMJ DISORDERS AND THE CERVICAL SPINE

Although usually multifactorial, disorders of the TMJ which may affect the cervical spine may be categorised into functional and anatomical.

The TMJ and the cervical spine are functionally interrelated and the malposition of one can affect the position and function of the other (4). De Steno (14) states "The muscles of the head and neck are either directly or indirectly involved in mandibular movement". Improper jaw relationship may cause biomechanical stress which results in compensatory adjustments by all the parts involved in the activity. Further, according to Lieb (11) "Studies in anatomy, physiology, body mechanics, kinesiology and neuromuscular function all lead to the ready realisation that the proper relationship of the head upon the spine is essential to proper total body posture and balance".

Postural maintenance of the head is achieved through a muscle "chain". The shoulder girdle, clavicle, sternum and scapular are the anchor points, with the head teetering on the atlanto-occipital joints with its centre of gravity in front of the occiput condyles. In order to maintain the head in the erect position, action of the large posterior neck muscles is needed. The anterior muscles, principally the masticatory, supra and infrahyoid groups add to the force of gravity thereby loading the posterior cervical muscles. The "chain" is formed by the anterior muscle attachments to the mandible and hyoid bones, as they link the cranium to the shoulder girdle. Therefore any alteration of this functional "chain", anywhere along its course will be reflected elsewhere along its length (7).

The functional relationship between the craniovertebral joints and mandible movement is also significant, within this context. The attachment of the trapezius, platysma, sternomastoid, digastric, supra and infrahyoid and the longus capitus muscles and the intimate functional relationship between opening of the jaw and extension form a rational link between the TMJ and the craniovertebral joints (8). When this functional relationship is disturbed the ramifications may manifest themselves in any of the involved structures.

From a functional perspective Grieve (3) states "patients with hyperactivity of the masticatory muscles may also develop simultaneous hyperactivity of the sternomastoid muscles". This may result in an abnormal loss of the cervical lordosis and in some patients extension malposition of the upper cervical joint complex. The consequences of such changes in the cervical spine become obvious and may if they become chronic lead to dysfunctions such as joint hyper-hypo-mobility and biomehcanical joint stress.

One clinical presentation described by Rocabado (8), which outlines this inter-relationship, involves a patient with an unconscious habit of teeth grinding. In this case the patient presented with a postural tendency to side flexion and rotation of the head, painful unilateral scalenus anticus syndrome and a tendency to raise the shoulder on the same side. These manifestations were accompanied by headache, temporal pain and hyper-activity of the jaw musculature.

Anatomically the close relationship between the spinal tract of the trigeminal nerve and the cervical spine must also be considered. As previously stated the spinal tract of the trigeminal nerve descends to the level of C3 and receives all nociceptive and thermal inputs from the Vth, VIIth, Xth, XIth cranial nerves and the C1, C2 and C3 dorsal roots. Because afferent neurons also travel in the motor root of the Vth cranial nerve, nociceptive impulses from any area these nerves serve may produce facilitation effects, resulting in the clinical manifestations of combined musculo-skeletal neck and jaw dysfunction (2). The trigeminal system also plays an important role in the motor control of cervical muscles and head movement, in addition to its role of nociceptive transmission from orofacial tissues (17). The cervical nerves C1 to C4 are primarily concerned with head posture (18) and afferent fibres from these cervical nerves relay to the nucleus caudalis of the trigeminal system, thus providing a plausible link between TMJ dysfunction and cervical spine posture. Similarly Lieb (11) states, with regard to the former neurological connections, that noci-stimuli from any peripheral source can easily "jump" to other parts of the neural system giving us a wide variety of clinically observed symptoms, including bizarre neuralgia's and pain syndromes.

Kraus (2) explores in great detail the above neurological inter-relationships and their affects of head and neck posture on the TMJ. He proposes that abnormal neck and head posture may not only contribute to faulty maxillo-mandibular relationships and movement but may also adversely affect mandibular development and craniofacial morphology. Although the majority of the evidence presented is concerned with cervical spine influences on the TMJ the reverse may also be true and Kraus provides some research to support this hypothesis. Head and neck posture is in dynamic equilibrium, constantly responding to environmental demands, and is dependent both peripheral and central control mechanisms.

The peripheral mechanism is comprised of three systems: the vestibular system; ocular system; and proprioceptive system. The combined effects of these three systems working in concert achieve final head neck posture. The proprioceptive system consists of the muscles spindle and the tonic neck reflex (TNR). Although the ocular and vestibular systems play an important role in postural maintenance, with the latter having neurological connections in the upper cervical spine, Kraus believes that the TNR plays the most significant role.

The TNR is the earliest detectable reflex in the human embryo and is present at 7½ weeks of menstrual age (19) and amongst other things helps the foetus conform to the uterine cavity (20). The TNR originates in the mechano-receptors of the upper cervical spine (21) and plays the major role in orienting an organism in its environment and the maintenance of dynamic equilibrium (13).

Kraus postulates that either macro or micro trauma to the neck proprioceptors results in self-perpetuating cycle of improper positioning and movement of the head and neck. Microtrauma refers to positions and movements to which we subject our musculo-skeletal system, that in turn abuse our neck proprioceptors.

The TNR has a significant influence on jaw muscle activity and in particular those muscles innervated by the trigeminal system (23), via the trigeminal mesencephalic nucleus in the superior colliculus (24)(25). Trigemino-neck reflexes have been demonstrated to occur through motor neurons located in the subnucleus caudialis and probably in the dorsal horn of the upper cervical spine (26). Kraus cites one study (25) to highlight this connection. "The effect the TNR plays on jaw muscle activity is appreciated by observing animals biting on a hard object such as bone or nut between the right molars. The animal turns its head to the left and tilts it to the right. The head position causes an increased masticatory muscle tone and a shift of the mandible to the working side". It could be argued that through this relationship and the convergence of the trigeminal and cervical root fibres on the same sensory neurons, at higher levels in the cord, that nociceptor input and or hyper-activity from the jaw muscles may constitute microtrauma and adversely affect the TNR, resulting in faulty head-neck posture.

Kraus further expands on the functional inter-relationship between the TMJ and cranio-cervical posture in a discussion on changes in the vertical dimension of occlusion (VDO). The VDO is the distance designated from the base of the nose to the base of the chin when the teeth are in maximum intercuspation (27) and is used by dentists for diagnostic and therapeutic purposes.

When the VDO is increased supramandibular muscle activity is decreased (28)(29) which may in turn, through synergic muscle activity and neural organisation of the trigemino-neck reflex, result in decreased posterior neck muscle activity. After introduction of an intraoral appliance, which increased the VDO, Daly (30) found that 90% of his thirty male subjects acquired extension of the head upon the neck within one hour. A later study by Kraus (31) resulted in similar cranio-cervical changes.

CONCLUSION

With respect to the above discussion it appears that there is a close relationship, both anatomically and functionally, between the TMJ and cervical spine. It is incumbent on the clinician to recognise this relationship when evaluating cervical spine dysfunction, particularly that of a long standing nature. "Chronic abnormalities of dentition, of oral articulation of the joints of the jaw and of the craniovertebral region, and of the masticatory and suboccipital muscles, are likely to affect one or other member of this interdependent family, with persistent effects often spreading further afield"(3).

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